CLAIMS

1. An optical signal transmitting apparatus for transmitting a FM batch converted signal with a frequency-multiplexed first signal being frequency-modulated in batch and a second signal as an optical signal, the apparatus is configured to transmit the optical signal including the FM batch converted signal and the second signal wherein:

the center frequency of the FM batch converted signal is set to be less than or equal to a value obtained by subtracting the half of the occupied frequency bandwidth of the FM batch converted signal and the half of the occupied frequency bandwidth of the second signal from the center frequency of the second signal.

2. The optical signal transmitting apparatus as set forth in claim 1, the apparatus comprises:

a frequency multiplexing means for frequency-multiplexing the FM batch converted signal and the second signal; and

an optical transmitter for intensity-modulating an optical signal with the signal frequency-multiplexed by the frequency multiplex means.

3. The optical signal transmitting apparatus as set forth in claim 1, the apparatus comprises:

a first optical transmitter for intensity-modulating an optical signal with the FM batch converted signal;

a second optical transmitter for intensity-modulating an optical signal with the second signal; and

an optical multiplexer for multiplexing the optical signal from the first optical transmitter and the optical signal from the second optical transmitter.

4. The optical signal transmitting apparatus as set forth in claim 3, wherein:

the wavelength of the optical signal from the second optical transmitter and the wavelength of the optical signal from the first optical transmitter are separated to reduce interference noise.

5. The optical signal transmitting apparatus as set forth in claim 1, the apparatus comprises:

an optical transmitter for intensity-modulating the optical signal with the FM batch converted signal; and

an external modulator for further intensity-modulating the optical signal with the second signal, the optical signal being intensity-modulated by the optical transmitter,.

6. The optical signal transmitting apparatus as set forth in claim 1, the apparatus comprises:

an optical transmitter for intensity-modulating the optical signal with the second signal; and

an external modulator for further intensity-modulating the optical signal with the FM batch converted signal, the optical signal being intensity-modulated by the optical transmitter.

7. An optical signal receiving apparatus for receiving an optical signal including a FM batch converted signal with a frequency-multiplexed first signal being frequency-modulated in batch and a second signal, the apparatus is configured to receive the optical signal to demodulate the FM batch converted signal and the second signal, wherein:

the center frequency of the FM batch converted signal is set to be less than or equal to a value obtained by subtracting the half of the occupied frequency bandwidth of the FM batch converted signal and the half of the occupied frequency bandwidth of the second signal from the center frequency of the second signal.

8. The optical signal receiving apparatus as set forth in claim 7, the apparatus comprises:

an optical receiver for converting the received optical signal to an electrical signal;

a first filter for passing the FM batch converted signal included in the converted electrical signal;

a second filter for passing the second signal included in the converted electrical signal; and

an FM demodulator for demodulating the FM batch converted signal passed through the first filter, to the first signal.

9. The optical signal receiving apparatus as set forth in claim 7, the apparatus comprises:

an optical receiver for converting the received optical signal to an electrical signal;

a first amplifier for selectively amplifying the FM batch converted signal included in the converted electrical signal;

a second amplifier for selectively amplifying the second signal included in the converted electrical signal; and

an FM demodulator for demodulating the FM batch converted signal amplified by the first amplifier, to the first signal.

10. The optical signal receiving apparatus as set forth in claim 7, the apparatus comprises:

an optical receiver for converting the received optical signal to an electrical signal;

an FM demodulator for demodulating the FM batch converted signal included in the converted electrical signal to the first signal; and

a down-converter for down-converting the second signal included in the converted electrical signal for output.

11. An optical signal transmission system, comprising:

the optical signal transmitting apparatus as set forth in any one of claims 1 to 6; and

the optical signal receiving apparatus as set forth in any one of claims 7 to 10.

12. An optical signal relaying apparatus for transferring an optical signal including a FM batch converted signal with a frequency-multiplexed first signal being frequency-modulated in batch and a second signal, the apparatus is configured to receive the optical signal including one of the FM batch converted signal and the second signal and to add it with the other signal to transmit, wherein:

the center frequency of the FM batch converted signal is set to be less than or equal to a value obtained by subtracting the half of the occupied frequency bandwidth of the FM batch converted signal and the half of the occupied frequency bandwidth of the second signal from the center frequency of the second signal.

13. The optical signal relaying apparatus as set forth in claim 12, the apparatus comprises:

an optical multiplexer for multiplexing the optical signal including the FM batch converted signal and the optical signal including the second signal.

14. The optical signal relaying apparatus as set forth in claim 13, wherein:

the wavelength of the optical signal including the second signal and the wavelength of the optical signal including the FM batch converted signal are separated to reduce interference noise.

15. The optical signal relaying apparatus as set forth in claim 12, the apparatus comprises:

an external modulator for intensity-modulating the optical signal with the second signal, the optical signal including the FM batch converted signal.

16. The optical signal relaying apparatus as set forth in claim 12, the apparatus comprises:

an external modulator for intensity-modulating the optical signal with FM batch converted signal, the optical signal including the second signal.

17. An optical signal transmission system comprising:

the optical signal relaying apparatus as set forth in any one of claims 12 to 16; and

the optical signal receiving apparatus as set forth in any one of claims 7 to 10.

18. An optical signal transmitting method for transmitting a FM batch converted signal with a frequency-multiplexed first signal being converted and frequency-modulated and a second signal as an optical signal, the method includes transmitting the optical signal including the FM batch converted signal and the second signal wherein:

the center frequency of the FM batch converted signal is set to be less than or equal to a value obtained by subtracting the half of the occupied frequency bandwidth of the FM batch converted signal and the half of the occupied frequency bandwidth of the second signal from the center frequency of the second signal.

19. The optical signal transmitting method as set forth in claim 18, the method includes the steps of:

frequency-multiplexing the FM batch converted signal and the second signal; and

intensity-modulating an optical signal with the frequency-multiplexed signal.

20. The optical signal transmitting method as set forth in claim 18, the method includes the steps of:

intensity-modulating an optical signal with the FM batch converted signal;

intensity-modulating an optical signal with the second signal; and

multiplexing the optical signal intensity-modulated with the FM batch converted signal and the optical signal intensity-modulated with the second signal.

21. The optical signal transmitting method as set forth in claim 20, wherein:

at the multiplexing step, the wavelength of the optical signal intensity-modulated with the second signal and the wavelength of the optical signal intensity-modulated with the FM batch converted signal are separated to reduce interference noise.

22. The optical signal transmitting method as set forth in claim 18, the method include the steps of:

intensity-modulating an optical signal with the FM batch converted signal; and

further intensity-modulating the intensity-modulated optical signal with the second signal.

23. The optical signal transmitting method as set forth in claim 18, the method includes the steps of:

intensity-modulating an optical signal with the second signal; and

further intensity-modulating the intensity-modulated optical signal with the FM batch converted signal.

24. An optical signal receiving method for receiving an optical signal including a FM batch converted signal with a frequency-multiplexed first signal being frequency-modulated in batch and a second signal, the method includes receiving the optical signal to demodulate the FM batch converted signal and the second signal, wherein:

the center frequency of the FM batch converted signal is set to be less than or equal to a value obtained by subtracting the half of the occupied frequency bandwidth of the FM batch converted signal and the half of the occupied frequency bandwidth of the second signal from the center frequency of the second signal.

25. The optical signal receiving method as set forth in claim 24, the method includes the steps of:

converting the received optical signal to an electrical signal;

selectively passing the FM batch converted signal included in the converted electrical signal;

selectively passing the second signal included in the converted electrical signal; and

demodulating the FM batch converted signal selectively passed, to the first signal.

26. The optical signal receiving method as set forth in claim 24, the method includes the steps of:

converting the received optical signal to an electrical signal;

selectively amplifying the FM batch converted signal included in the converted electrical signal;

selectively amplifying the second signal included in the converted electrical signal; and

demodulating the FM batch converted signal selectively amplified, to the first signal.

27. The optical signal receiving method as set forth in claim 24, the method comprises the steps of:

converting the received optical signal to an electrical signal;

demodulating the FM batch converted signal included in the converted electrical signal to the first signal; and

down-converting the second signal included in the converted electrical signal.

28. An optical signal transmission method including:

the optical signal transmitting method as set forth in any one of claims 18 to 23; and

the optical signal receiving method as set forth in any one of claims 24 to 27.

29. An optical signal relaying method for transferring an optical signal including a FM batch converted signal with a frequency-multiplexed first signal being frequency-modulated in batch and a second signal, the method includes receiving the optical signal including one of the FM batch converted signal and the second signal and adding it with the other signal to transmit, wherein:

the center frequency of the FM batch converted signal is set to be less than or equal to a value obtained by subtracting the half of the occupied frequency bandwidth of the FM batch converted signal and the half of the occupied frequency bandwidth of the second signal from the center frequency of the second signal.

30. The optical signal relaying method as set forth in claim 29, the method includes the step of:

multiplexing the optical signal including the FM batch converted signal and the optical signal including the second signal.

31. The optical signal relaying method as set forth in claim 30, wherein:

at the multiplexing step, the wavelength of the optical signal including the second signal and the wavelength of the optical signal including the FM batch converted signal are separated to reduce interference noise.

32. The optical signal relaying method as set forth in claim 29, the method includes the step of:

intensity-modulating the optical signal including the FM batch converted signal with the second signal.

33. The optical signal relaying method as set forth in claim 29, the method includes the step of:

intensity-modulating the optical signal including the second signal with the FM batch converted signal.

34. An optical signal transmission method comprising:

the optical signal relaying method as set forth in any one of claims 29 to 33; and

the optical signal receiving method as set forth in any one of claims 24 to 27.